

REMARKS

Reconsideration and allowance are respectfully requested.

Claims 1-2 and 7-24 are pending. Claims 4-5 were withdrawn from consideration; they are canceled without prejudice or disclaimer to their prosecution in a future application. Claim 1 is generic for the elected and the nonelected inventions. Rejoinder of the subject matter directed to nonelected inventions is requested upon an indication that a generic claim is allowable.

The amendments are fully supported by the original disclosure and, thus, no new matter is added by their entry. Support may be found, *inter alia*, in original claims 6 and in the examples that use a zeolite-Y catalyst.

35 U.S.C. 112 – Enablement

The Patent Office has the initial burden to question the enablement provided for the claimed invention. M.P.E.P. § 2164.04, and the cases cited therein. It is incumbent upon the Patent Office, whenever a rejection on this basis is made, to explain why it doubts the truth or accuracy of any statement in a supporting disclosure and to back up assertions of its own with acceptable evidence or reasoning which is inconsistent with the contested statement. *In re Marzocchi*, 169 USPQ 367, 370 (C.C.P.A. 1971). Specific technical reasons are always required. See M.P.E.P. § 2164.04.

Claims 1-3 and 6-16 were rejected under Section 112, first paragraph, because they allegedly fail to comply with the enablement requirement. It was alleged, “While the specification has provided process while being enabled for making ethylene-cyclic carbonate by reacting epichlorohydrin and carbon dioxide in the presence of said catalyst, does not reasonably provide enablement for making other cyclic carbonate by reacting an epoxide or olefin with carbon dioxide under said condition.” Applicants traverse because their claimed invention provide a specific catalyst that is able to accept substrates such as olefins or epoxides thereof to produce cyclic carbonates.

Applicants’ claim 1 is directed to the use of a zeolite-Y catalyst encapsulating a specific organometallic complex (i.e., comprising a transition metal ion which is Al, Cu, Co or Ni and a coordinating ligand which is a phthalocyanine) and a Lewis base co-

catalyst. Such catalysts can accept a variety of olefins or epoxides thereof to produce cyclic carbonates. By its terms, claim 1 specifies the starting materials (i.e., an olefin or epoxide thereof) and the final products (i.e., a cyclic carbonate). In accordance with the teachings provided in Applicants' specification as well as their examples, a person of skill in the art would be able to practice the claimed invention without undue experimentation. Each combination of catalyst and starting material would be reacted under the stated conditions (e.g., carbon dioxide, solvent, and Lewis base co-catalyst) by routine manipulations that are well within the skill in the art. The objective truth of Applicants' teachings were not contradicted by any evidence or reasoning in the record. Thus, no requirement for undue experimentation was established in the Office Action. In particular, the assertion on page 5 of the Action that epoxide needs to be canceled as a starting material and the size of the cyclic carbonate needs to be specifically defined are not well taken. As evidence of the level of skill in the art, two patents are attached for the Examiner's consideration: US 6,534,670 B2 and US 7,145,029 B2 do not "specifically define" the structure of the cyclic carbonates in their process claims.

Claim 9 was rejected under Section 112, first paragraph, because it was alleged that "the specification, while being enabling for making ethylene-cyclic carbonate in a halogenated quite non-polar aprotic solvent of 1,2-dichloromethane does not reasonably provide enablement for making said cyclic carbonates in the other strong polar protic solvents such as methanol or water as being claimed." Applicants traverse for reasons similar to that above: i.e., the objective truth of their teachings were not contradicted by any evidence or reasoning in the record.

Applicants' claim 1 is directed to the use of a zeolite-Y catalyst encapsulating a specific organometallic complex (i.e., comprising a transition metal ion which is Al, Cu, Co or Ni and a coordinating ligand which is a phthalocyanine) and a Lewis base co-catalyst. Different solvents may be used to dissolve starting materials of the process. Use of non-polar solvents were exemplified in Applicants' specification, but both polar and non-polar solvents were taught therein. Dichloromethane (methylene chloride) is not a strong non-polar solvent. The dipole moment is 1.60 for dichloromethane and it is 1.70 for methanol. The process claimed by Applicants can be used with a polar or non-

polar solvent by routine manipulation of the reaction conditions. There was no requirement for undue experimentation established in the Office Action. It was asserted on page 5 of the Action that “the specification . . . does not reasonably provide enablement for making said cyclic carbonates in the other strong polar protic solvents such as methanol or water.” In contradiction, such solvents are able to preparation cyclic carbonates as evidenced by another patent attached for the Examiner's consideration: US 4,331,604 claiming many different polar solvents in claim 2.

Claim 10 was rejected under Section 112, first paragraph, because it was alleged that “the specification, while being enabling for making ethylene-cyclic carbonate in the presence of DMAP (N,N'-dimethylamino pyridine) does not reasonably provide enablement for making said cyclic carbonates in the other Lewis base co-catalysts such as alkyl phosphine, aryl phosphine, phosphonium or alkyl ammonium salts as being claimed.” Applicants traverse for reasons similar to that above: i.e., the objective truth of their teachings were not contradicted by any evidence or reasoning in the record.

Applicants' claim 1 is directed to the use of a zeolite-Y catalyst encapsulating a specific organometallic complex (i.e., comprising a transition metal ion which is Al, Cu, Co or Ni and a coordinating ligand which is a phthalocyanine) and a Lewis base co-catalyst. Catalysis by the Lewis base involves formation of a Lewis adduct as a reaction intermediate. This mechanism donates a pair of electrons. Lewis bases such as alkyl phosphine, aryl phosphine, alkyl ammonium salts, and phosphonium salts can be used in the claimed process because the mechanism of catalysis is similar (i.e., predictable). Also Lewis bases are known to enhance the solubility of compounds in carbon dioxide. Submitted for the Examiner's consideration is US 5,744,554 claiming many different Lewis bases to catalyze a reaction in claim 6.

Withdrawal of the enablement rejections on pages 3-6 of the Action is requested because it would not require undue experimentation for a person of skill in the art to make and use the claimed invention.

35 U.S.C. 112 – Written Description

The specification must convey with reasonable clarity to persons skilled in the art that applicant was in possession of the claimed invention as of the filing date sought. See *Vas-Cath v. Mahurkar*, 19 USPQ2d 1111, 1117 (Fed. Cir. 1991). But the Patent Office has the initial burden of presenting evidence or a reason why persons of ordinary skill in the art would not have recognized such a description of the claimed invention in the original disclosure. See *In re Gosteli*, 10 USPQ2d 1614, 1618 (Fed. Cir. 1989). A specification need not teach, and preferably omits, what is well known in the art. See *Hybritech v. Monoclonal Antibodies*, 231 USPQ 81, 94 (Fed. Cir. 1986).

Claim 1 was rejected under Section 112, first paragraph, because it allegedly fails to comply with the written description requirement. Applicants traverse because the specification teaches a representative number of species within the claimed genus of compounds. The genres of cyclic carbonates, olefins, zeolite-Y catalysts, and Lewis base co-catalysts are well known in the art. Their chemical structures and their functions in the context of the claimed process were in Applicants' possession because each component of the reaction is represented by a number of different species taught by them in their specification as well as the fact that these classes of compound are known in the art. The phrase "oxygen-containing compound" is deleted because this limitation is not required for patentability.

Claim 10 was rejected under Section 112, first paragraph, because it allegedly fails to comply with the written description requirement. Applicants traverse because the specification teaches a representative number of species within the claimed genus of compounds. The genus of Lewis base co-catalysts is well known in the art. Its chemical structure and its functions in the context of the claimed process were in Applicants' possession because each component of the reaction is represented by a number of different species taught by them in their specification as well as the fact that these classes of compound are known in the art. In particular, a pyridine derivative is not indefinite because a person of skill in the art would readily recognize whether a specific compound (e.g., DMAP) was within the scope of this limitation.

Claim 10 was rejected under Section 112, first paragraph, because it allegedly fails to comply with the written description requirement. Applicants traverse because the organometallic complex is suitably defined. It encapsulates an organometallic complex that comprises (i) a transition metal ion which is Al, Cu, Co or Ni and (ii) a coordinating ligand which is a phthalocyanine.

Withdrawal of the written description rejections on pages 6-8 of the Action is requested because the specification conveys to a person skilled in the art that Applicants were in possession of the claimed invention as of the filing date.

35 U.S.C. 112 – Definiteness

Claims 3, 6 and 16 were rejected under Section 112, second paragraph, as being allegedly “indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.” Applicants traverse.

Cancellation of claims 3 and 6 moots their rejection.

Antecedent basis in claim 16 is corrected.

Applicants request withdrawal of the Section 112, second paragraph, rejections because the pending claims are clear and definite.

35 U.S.C. 103 – Nonobviousness

To establish a case of prima facie obviousness, all of the claim limitations must be taught or suggested by the prior art. See M.P.E.P. § 2143.03.

A claimed invention is unpatentable if the differences between it and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art. *In re Kahn*, 78 USPQ2d 1329, 1334 (Fed. Cir. 2006) citing the legal standard provided in *Graham v. John Deere*, 148 USPQ 459 (1966). The *Graham* analysis needs to be made explicitly. *KSR v. Teleflex*, 550 US ___, slip op. 14 (2007). It requires findings of fact and a rational basis for combining the prior art disclosures to produce the claimed invention. See *id.* (“Often, it will be necessary for a court to look to interrelated teachings of multiple patents . . . and the background knowledge possessed by a person having ordinary skill in the art, all in

order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue"). The use of hindsight reasoning is impermissible. See *KSR*, slip op. 17 ("A factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning"). Thus, a rejection under Section 103(a) requires "some rationale, articulation, or reasoned basis to explain why the conclusion of [prima facie] obviousness is correct." *Kahn*, 78 USPQ2d at 1335; see *KSR*, slip op. 14. An inquiry should be made as to "whether the improvement is more than the predictable use of prior art elements according to their established functions." *KSR*, slip op. 13. But a claim which is directed to a combination of prior art elements "is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR*, slip op. 14. Finally, a determination of prima facie obviousness requires a reasonable expectation of success. See *In re Rinehart*, 189 USPQ 143, 148 (C.C.P.A. 1976).

Claims 1-3 and 6-16 were rejected under Section 103(a) as allegedly unpatentable over Kim et al. (U.S. Patent 6,407,264) in view of Sabater et al. (Chem. Comm., 1285-1286, 1997). Applicants traverse.

Kim et al. disclose preparation of alkylene carbonate by reacting alkylene oxide and carbon dioxide in the presence of a catalyst system comprising a metal halide and pyridine or pyridine derivative. The zeolite-Y catalyst of Applicants' claim 1 is entirely different from the catalyst system of Kim et al.

Sabater et al. disclose preparation of a chiral (salen) manganese complex analogous to a Jacobsen catalyst into the supercages of large pore Y zeolite. The process consists of condensation of optically active trans-(R,R)-1,2-diaminocyclohexane and salicylaldehyde around Mn^{II} metal ions resident in supercages and a final oxidation step. This explicitly teach the preparation of a heterogeneous enantioselective catalyst for epoxidation of alkenes.

Applicants' claim 1 is directed to a process for preparation of cyclic carbonates. The reaction takes place between (i) an olefin or an epoxide thereof reacting with (ii) at least carbon dioxide in the presence of a zeolite-Y catalyst and a Lewis base co-catalyst. Neither the cited documents taken by themselves or in combination teach or

suggest preparation of cyclic carbonates using a zeolite Y catalyst and a Lewis base co-catalyst.

Withdrawal of the Section 103 rejection is requested because the claimed invention would not have been obvious to the ordinarily skilled artisan at the time Applicants made their invention.

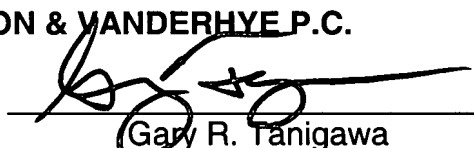
Conclusion

Having fully responded to all of the pending objections and rejections contained in this Office Action, Applicants submit that the claims are in condition for allowance and earnestly solicit an early Notice to that effect. The Examiner is invited to contact the undersigned if any further information is required.

Respectfully submitted,

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Enclosures: U.S. Patent No. 4,331,604

U.S. Patent No. 5,744,554

U.S. Patent No. 6,534,670 B2

U.S. Patent No. 7,145,029 B2

"Solvents" from the University of Southern Maine's O=Chem directory



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Solvents

Introduction

The vast majority of chemical reactions are performed in solution. The solvent fulfills several functions during a chemical reaction. It solvates the reactants and reagents so that they dissolve. This facilitates collisions between the reactant(s) and reagents that must occur in order to transform the reactant(s) to product(s). The solvent also provides a means of temperature control, either to increase the energy of the colliding particles so that they will react more quickly, or to absorb heat that is generated during an exothermic reaction. The selection of an appropriate solvent is guided by theory and experience. Generally a good solvent should meet the following criteria.

- It should be inert to the reaction conditions.
- It should dissolve the reactants and reagents.
- It should have an appropriate boiling point.
- It should be easily removed at the end of the reaction.

The second criterion invokes the adage "Like dissolves like". Non-polar reactants will dissolve in non-polar solvents. Polar reactants will dissolve in polar solvents. For our purposes there are three measures of the polarity of a solvent:

1. Dipole moment
2. Dielectric constant
3. Miscibility with water

Molecules with large dipole moments and high dielectric constants are considered polar. Those with low dipole moments and small dielectric constants are classified as non-polar. On an operational basis, solvents that are miscible with water are polar, while those that are not are non-polar; remember the saying "Oil and water don't mix".

Chemists have classified solvents into three categories according to their polarity.

1. polar protic
2. dipolar aprotic
3. non-polar.

Polar Protic Solvents

Let's start with the meaning of the adjective protic. In the context used here, protic refers to a hydrogen atom attached to an electronegative atom. For our purposes that electronegative atom is almost exclusively oxygen. In other words, polar protic solvents are compounds that can be represented by the general formula ROH. The polarity of the polar protic solvents stems from the bond dipole of the O-H bond. The large difference in electronegativities of the oxygen and the hydrogen atom, combined with the small size of the hydrogen atom, warrant separating molecules that contain an OH group from those polar compounds that do not. Examples of polar protic solvents are water (HOH), methanol (CH₃OH), and acetic acid (CH₃CO₂H).

Dipolar Aprotic Solvents


Here the key word is aprotic. In the context used here, aprotic describes a molecule that does not contain an O-H bond. Solvents in this class all contain a bond that has a large bond dipole. Typically this bond is a multiple bond between carbon and either oxygen or nitrogen. Most dipolar aprotic solvents contain a C=O double bond. Examples are acetone [(CH₃)₂C=O] and ethyl acetate (CH₃CO₂CH₂CH₃).

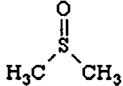

Non-Polar Solvents

Non-polar solvents are compounds that have low dielectric constants and are not miscible with water. Examples include benzene (C_6H_6), carbon tetrachloride (CCl_4), and diethyl ether ($CH_3CH_2OCH_2CH_3$).

Table 1 presents a list of solvents that are commonly used in chemical reactions. The boiling point, dipole moment, and dielectric constant of each solvent is included. All of these solvents are clear, colorless liquids. The hydrogen atoms of the protic solvents are highlighted in red.

Table 1
Common Solvents for Organic Reactions

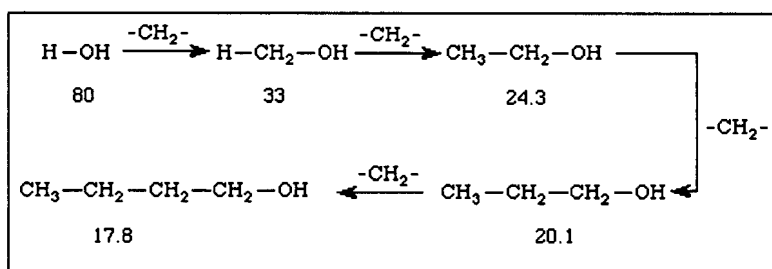
Name	Structure	bp, °C	dipole moment	dielectric constant
water	H-OH	100	1.85	80
methanol	CH ₃ -OH	68	1.70	33
ethanol	CH ₃ CH ₂ -OH	78	1.69	24.3
1-propanol	CH ₃ CH ₂ CH ₂ -OH	97	1.68	20.1
1-butanol	CH ₃ CH ₂ CH ₂ CH ₂ -OH	118	1.66	17.8
formic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}-\text{C}-\text{OH} \end{array}$	100	1.41	58
acetic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{C}-\text{OH} \end{array}$	118	1.74	6.15
formamide	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}-\text{C}-\text{NH}_2 \end{array}$	210	3.73	109
••••	••••	••••	••••	••••
acetone	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{C}-\text{CH}_3 \end{array}$	56	2.88	20.7
tetrahydrofuran (THF)		66	1.63	7.52
methyl ethyl ketone	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{C}-\text{CH}_2\text{CH}_3 \end{array}$	80	2.78	18.5
ethyl acetate	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{C}-\text{OCH}_2\text{CH}_3 \end{array}$	78	1.78	6.02
acetonitrile	H ₃ C-C≡N	81	3.92	36.6
N,N-dimethylformamide (DMF)	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}-\text{C}-\text{N}(\text{CH}_3)_2 \end{array}$	153	3.82	38.3
dimethyl sulfoxide (DMSO)		189	3.96	47.2

				
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hexane	$\text{CH}_3(\text{CH}_2)_4\text{CH}_3$	69	----	2.02
benzene		80	0	2.28
diethyl ether	$\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$	35	1.15	4.34
methylene chloride	CH_2Cl_2	40	1.60	9.08
carbon tetrachloride	CCl_4	76	0	2.24

It should be apparent from the table that there are no sharp boundaries between polar and non-polar solvents, at least if you use dielectric constants or dipole moments as a measure. There is, however, a correlation between chemical structure and dielectric constant that provides a useful way to think about polarity. Look at the series of polar protic compounds water, methanol, ethanol, 1-propanol, and 1-butanol. As Figure 1 demonstrates, each compound in the series differs from the ones before and after it by one CH_2 group.

Figure 1

Structure-Property Correlations



As the number of CH_2 groups in ROH increases, the dielectric constant decreases. If you think of these molecules as containing a polar component (OH) and a non-polar component (R), then the polarity of a compound reflects the balance between these two components. As the relative amount of hydrocarbon character increases, the polarity decreases. Note that hexane, which is 100% hydrocarbon, is the least polar solvent in the table.